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Aug. 12-1931

SOLAR/1056-78/11

Monthly Performance Report

M. F. SMITH ASSOCIATES

NOVEMBER 1978

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

NOTICE

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MONTHLY PERFORMANCE REPORT

M. F. SMITH ASSOCIATES

NOVEMBER 1978

I. SYSTEM DESCRIPTION

M. F. Smith Associates is a single-family residence in Jamestown, Rhode Island. The home has approximately 2240 square feet of conditioned space. Solar energy is used for space heating the home and preheating domestic hot water (DHW). The solar energy system has an array of flat-plate collectors with a gross area of 512 square feet. The array faces 15 degrees west of south at an angle of 45 degrees to the horizontal. Water is the transfer medium that delivers solar energy from the collector array to storage and to the space heating and hot water loads. Solar energy is stored in a 3150-gallon concrete storage tank. City water is preheated in storage and in heat exchanger HW1, which receives energy from a coil at the output of the heat pump compressor. Preheated water is supplied, on demand, to a conventional 82-gallon DHW tank. Solar-heated water from the storage tank is directed to a heat pump or to an hydronic heat exchanger to provide space heating. When the storage water temperature is insufficient to satisfy the heat pump input requirements, an electrical heating element (booster unit HR1) in the line between storage and the heat pump provides auxiliary energy. During the cooling season, heat is removed from the conditioned space and discharged into storage, which should be maintained below 100°F by operating the collector system at night. An electrical heating element in the DHW tank provides auxiliary energy for water heating. The system, shown schematically in Figure 1, has three modes of solar operation.

Mode 1 - Collector-to-Storage: This mode activates when the temperature difference between the collectors and the bottom of storage is 20°F or higher. Pumps P1 and P2 circulate water from the storage tank through the collectors and back. Circulation continues until the temperature difference between the collector and storage falls to 5°F or less. If the temperature in a collector panel reaches 45°F, the collector array drains down.

Mode 2 - Storage-to-Space Heating: This mode activates when the manually set thermostat in the conditioned space zones 1 and 2 indicates a demand for heat. Pump P3 circulates water from storage to the heat pump in the energy conservation module (ECM). If the input water temperature is higher than 90°F, the water will be diverted to an hydronic heating coil. If the water temperature is less than 90°F, the water will be diverted to the heat pump.

Mode 3 - DHW Preheating: This mode activates when city water enters a heat exchanger in the storage tank and flows to the HW1 preheater which receives energy from a coil at the output of the heat pump compressor inside the ECM. When there is no draw, the ECM internal pump circulates hot water from HW2 to HW1, as long as HW1 remains hotter than HW2. If a draw occurs, water flows from HW1 to HW2 for a final temperature boost.

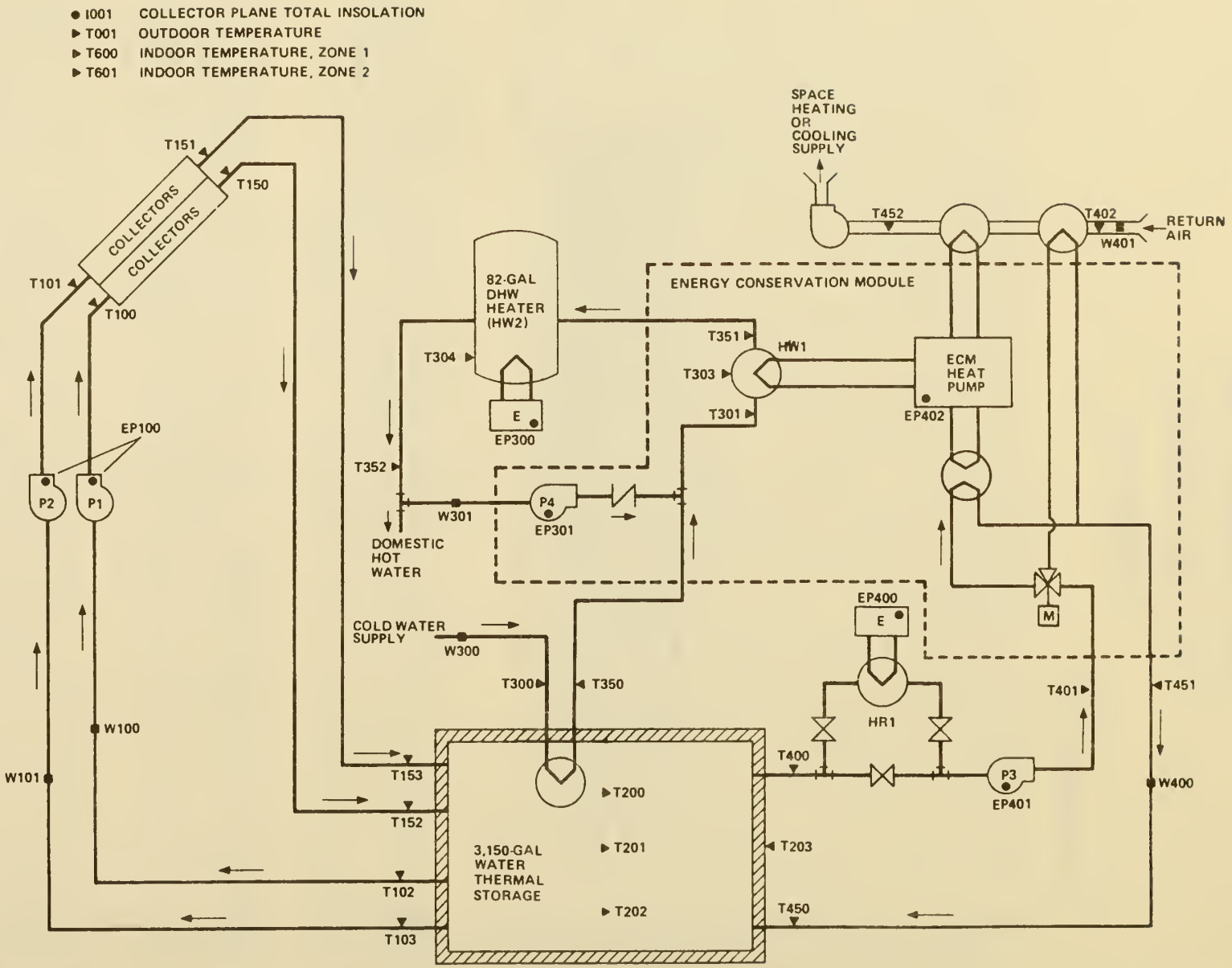

Figure 1. M. F. SMITH SOLAR ENERGY SYSTEM SCHEMATIC

II. PERFORMANCE EVALUATION

INTRODUCTION

The site was unoccupied in November; however, the solar energy system operated continuously during the month. Solar energy satisfied 80 percent of the space heating requirements. The solar energy system provided electrical energy savings of 1.3 million Btu.

WEATHER CONDITIONS

During the month, total incident solar energy on the collector array was 15.1 million Btu for a daily average of 985 Btu per square foot. This was below the estimated average daily solar radiation for this geographical area during November of 1088 Btu per square foot for a plane facing 15 degrees west of south with a tilt of 45 degrees to the horizontal. The average ambient temperature during November was 45°F and was equal to the long-term average for November. The number of heating degree-days for the month (based on a 65°F reference) was 603, as compared with the long-term average of 612.

THERMAL PERFORMANCE

Collector - The total incident solar radiation on the collector array for the month of November was 15.1 million Btu. During the period the collector loop was operating, the total insolation amounted to 12.9 million Btu. The total collected solar energy for the month of November was 4.1 million Btu, resulting in a collector array efficiency of 27 percent, based on total incident insolation. Operating energy required by the collector loop was 0.12 million Btu.

Storage - Solar energy delivered to storage was 4.1 million Btu. There were 3.1 million Btu delivered from storage to the space heating subsystem. Energy loss from storage was 2.4 million Btu and represented 60 percent of the energy delivered to storage. The storage efficiency was 40 percent: This is calculated as the ratio of the sum of the energy removed from storage and the change in stored energy, to the energy delivered to storage. The average storage temperature for the month was 90°F.

DHW Load - There was no DHW load during the month. Operating energy used by the DHW recirculation loop pump was 0.030 million Btu.

Space Heating Load - The space heating subsystem consumed 3.1 million Btu of solar energy and 0.76 million Btu of auxiliary electrical energy to satisfy a space heating load of 3.9 million Btu. The solar fraction of this load was 80 percent. The space heating subsystem consumed a total of 0.69 million Btu of operating energy, resulting in an electrical energy savings of 1.5 million Btu.

OBSERVATIONS

During the first half of the month, pump P3 did not indicate power consumption when sensor W400 indicated flow; therefore, the power consumption of pump P3 was estimated during this period.

On several days during the month the heat pump operated at 15- to 20-minute intervals for an entire 24-hour period in order to keep temperatures in heat zone 1 within the 69°F to 70°F range and temperatures in heat zone 2 within the 63°F to 65°F range. The outside ambient temperatures during these periods were usually in the lower 30-degree range.

ENERGY SAVINGS

The solar energy system provided a net electrical energy savings of 1.3 million Btu. The DHW subsystem incurred an electrical energy expense of 0.029 million Btu, while the space heating subsystem contributed an electrical energy savings of 1.5 million Btu.

III. ACTION STATUS

There are currently no action items.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND — SOLAR/1056-78/11
REPORT PERIOD: NOVEMBER,1978

SITE/SYSTEM DESCRIPTION:
THE M.F. SMITH SOLAR ENERGY SYSTEM PROVIDES SPACE HEATING AND DOMESTIC HOT WATER. THE SYSTEM USES WATER AS THE ENERGY COLLECTION, TRANSFER AND STORAGE MEDIUM. SOLAR HEATED WATER FROM THE STORAGE TANK IS DIRECTED TO A HEAT PUMP EXCHANGER TO PROVIDE SPACE HEATING. AN ELECTRIC BOILER PROVIDES AUXILIARY HOT WATER AS REQUIRED. MAKE-UP WATER FOR THE DHW SYSTEM PASSES THROUGH A HEAT EXCHANGER IN THE STORAGE TANK AND THEN TO A PRE-HEAT TANK. THE SOLAR HEATED WATER IS TRANSFERRED TO THE ELECTRIC HOT WATER TANK AS REQUIRED.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	15.125	MILLION BTU
	29541	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	4.113	MILLION BTU
	8034	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	45	DEGREES F
AVERAGE BUILDING TEMPERATURE	69	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.20	
ECSS OPERATING ENERGY	0.117	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	0.833	MILLION BTU
TOTAL ENERGY CONSUMED	5.504	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	-0.000	3.873	N.A.	3.873 MILLION BTU
SOLAR FRACTION	50	80	N.A.	80 PERCENT
SOLAR ENERGY USED	0.000	3.083	N.A.	3.083 MILLION BTU
OPERATING ENERGY	0.030	0.685	N.A.	0.833 MILLION BTU
AUX. THERMAL ENERGY	0.000	0.762	N.A.	0.762 MILLION BTU
AUX. ELECTRIC FUEL	0.000	0.762	N.A.	0.762 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	-0.029	1.461	N.A.	1.326 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.729

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND SOLAR/1056-78/11
REPORT PERIOD: NOVEMBER,1978

SITE/SYSTEM DESCRIPTION:
THE M.F. SMITH SOLAR ENERGY SYSTEM PROVIDES SPACE HEATING AND DOMESTIC HOT WATER. THE SYSTEM USES WATER AS THE ENERGY COLLECTION, TRANSFER AND STORAGE MEDIUM. SOLAR HEATED WATER FROM THE STORAGE TANK IS DIRECTED TO A HEAT PUMP EXCHANGER TO PROVIDE SPACE HEATING. AN ELECTRIC BOILER PROVIDES AUXILIARY HOT WATER AS REQUIRED. MAKE-UP WATER FOR THE DHW SYSTEM PASSES THROUGH A HEAT EXCHANGER IN THE STORAGE TANK AND THEN TO A PRE-HEAT TANK. THE SOLAR HEATED WATER IS TRANSFERRED TO THE ELECTRIC HOT WATER TANK AS REQUIRED.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	15.957	GIGA JOULES
	335469	KJ/SQ.M.
COLLECTED SOLAR ENERGY	4.340	GIGA JOULES
	91234	KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	7	DEGREES C
AVERAGE BUILDING TEMPERATURE	20	DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.20	
ECSS OPERATING ENERGY	0.124	GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	0.879	GIGA JOULES
TOTAL ENERGY CONSUMED	5.807	GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	-0.000	4.086	N.A.	4.086 GIGA JOULES
SOLAR FRACTION	50	80	N.A.	80 PERCENT
SOLAR ENERGY USED	0.000	3.253	N.A.	3.253 GIGA JOULES
OPERATING ENERGY	0.032	0.723	N.A.	0.879 GIGA JOULES
AUX. THERMAL ENG	0.000	0.804	N.A.	0.804 GIGA JOULES
AUX. ELECTRIC FUEL	0.000	0.804	N.A.	0.804 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	-0.031	1.541	N.A.	1.398 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.729

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND
REPORT PERIOD: NOVEMBER,1978

SOLAR/1056-78/11

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.918	48	0.000	N	0.007	N	0.000
2	1.050	51	0.000	O	0.008	O	0.000
3	1.066	51	0.000	T	0.008	T	0.000
4	0.323	51	0.000		0.002		0.000
5	0.183	50	0.000	A	0.000	A	0.000
6	0.124	50	0.000	P	0.001	P	0.000
7	0.546	55	0.000	P	0.005	P	0.000
8	0.064	49	0.008	L	0.000	L	0.321
9	1.024	51	0.014	I	0.008	I	0.020
10	0.908	51	0.000	C	0.007	C	0.000
11	0.166	52	0.000	A	0.000	A	0.000
12	0.170	44	0.081	B	0.000	B	0.599
13	0.783	42	0.072	L	0.007	L	0.112
14	0.158	56	0.045	E	0.000	E	*
15	0.897	52	0.101		0.007		*
16	0.538	43	0.083		0.005		0.172
17	0.138	47	0.172		0.000		1.385
18	0.714	58	0.032		0.006		0.048
19	0.957	46	0.073		0.008		0.086
20	0.941	41	0.092		0.007		0.112
21	0.080	34	0.231		0.000		3.008
22	0.098	33	0.256		0.000		2.545
23	0.248	37	0.195		0.002		0.750
24	0.134	45	0.132		0.001		0.945
25	0.574	37	0.268		0.005		0.457
26	1.036	26	0.312		0.007		0.288
27	0.107	27	0.302		0.000		2.663
28	0.078	36	0.216		0.000		2.562
29	0.476	40	0.184		0.007		0.363
30	0.626	44	0.129		0.006		0.195
SUM	15.125	-	2.997	N.A.	0.117	N.A.	-
AVG	0.504	45	0.100	N.A.	0.004	N.A.	0.204
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND SOLAR/1056-78/11
REPORT PERIOD: NOVEMBER,1978

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.918	0.815	0.240	55	0.262
2	1.050	0.953	0.299	60	0.285
3	1.066	0.995	0.316	62	0.297
4	0.323	0.193	0.031	55	0.096
5	0.183	0.081	0.000	52	0.000
6	0.124	0.055	0.009	*	0.070
7	0.546	0.465	0.126	61	0.231
8	0.064	0.025	0.000	*	0.000
9	1.024	0.954	0.320	57	0.313
10	0.908	0.822	0.281	60	0.310
11	0.166	0.067	0.000	55	0.000
12	0.170	0.072	0.000	47	0.000
13	0.783	0.734	0.234	46	0.298
14	0.158	0.051	0.000	58	0.000
15	0.897	0.807	0.309	55	0.345
16	0.538	0.468	0.154	47	0.285
17	0.138	0.056	0.000	49	0.000
18	0.714	0.671	0.264	65	0.370
19	0.957	0.877	0.317	52	0.331
20	0.941	0.832	0.299	46	0.318
21	0.080	0.036	0.000	33	0.000
22	0.098	0.042	0.000	34	0.000
23	0.248	0.151	0.021	39	0.085
24	0.134	0.077	0.002	46	0.012
25	0.574	0.510	0.176	*	0.306
26	1.036	0.945	0.311	29	0.300
27	0.107	0.043	0.000	25	0.000
28	0.078	0.029	0.000	33	0.000
29	0.476	0.428	0.166	42	0.348
30	0.626	0.594	0.238	*	0.381
SUM	15.125	12.846	4.113	-	-
AVG	0.504	0.428	0.137	48	0.272
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND SOLAR/1056-78/11
REPORT PERIOD: NOVEMBER,1978

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.240	0.000	0.015	116	0.063
2	0.299	0.000	0.042	117	0.140
3	0.316	0.000	0.054	119	0.169
4	0.031	0.000	-0.162	116	-5.215
5	0.000	0.000	-0.148	110	1.000
6	0.009	0.000	0.056	109	6.534
7	0.126	0.000	-0.055	109	-0.440
8	0.000	0.020	-0.133	104	1.000
9	0.320	0.020	0.097	104	0.368
10	0.281	0.000	0.077	108	0.274
11	0.000	0.000	-0.148	106	1.000
12	0.000	0.102	-0.204	99	1.000
13	0.234	0.087	0.017	95	0.446
14	0.000	*	-0.155	92	*
15	0.309	*	0.038	91	*
16	0.154	0.092	-0.040	91	0.340
17	0.000	0.191	-0.213	85	1.000
18	0.264	0.034	0.164	84	0.751
19	0.317	0.082	0.082	89	0.517
20	0.299	0.105	0.060	93	0.554
21	0.000	0.241	-0.264	88	1.000
22	0.000	0.250	-0.231	78	1.000
23	0.021	0.186	-0.144	71	1.969
24	0.002	0.127	-0.096	66	19.597
25	0.176	0.262	-0.019	65	1.386
26	0.311	0.299	0.012	65	1.000
27	0.000	0.284	-0.194	60	1.000
28	0.000	0.200	-0.131	54	1.000
29	0.166	0.173	0.024	53	1.184
30	0.238	0.122	0.177	56	1.256
SUM	4.113	3.083	-1.421	-	-
AVG	0.137	0.103	-0.047	90	0.404
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND
REPORT PERIOD: NOVEMBER,1978

SOLAR/1056-78/11

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	-0.000	50	0.000	0.000	0.000	0.000	N	0.000	N	60	140	0
2	0.000	0	0.000	0.000	0.000	0.000	O	0.000	O	60	140	0
3	0.000	0	0.000	0.000	0.000	0.000	T	0.000	T	60	140	0
4	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
5	0.000	0	0.000	0.000	0.000	0.000	A	0.000	A	60	140	0
6	0.000	0	0.000	0.000	0.000	0.000	P	0.000	P	60	140	0
7	0.000	0	0.000	0.000	0.000	0.000	P	0.000	P	60	140	0
8	0.000	0	0.000	0.001	0.000	0.000	L	-0.001	L	60	140	0
9	0.000	0	0.000	0.001	0.000	0.000	I	-0.001	I	60	140	0
10	0.000	0	0.000	0.000	0.000	0.000	C	0.000	C	60	140	0
11	0.000	0	0.000	0.000	0.000	0.000	A	0.000	A	60	140	0
12	0.000	0	0.000	0.007	0.000	0.000	B	-0.007	B	60	140	0
13	0.000	0	0.000	0.007	0.000	0.000	L	-0.007	L	60	140	0
14	0.000	0	0.000	0.004	0.000	0.000	E	-0.004	E	60	140	0
15	*	*	*	0.010	*	*		-0.009		60	*	0
16	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
17	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
18	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
19	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
20	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
21	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
22	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
23	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
24	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
25	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
26	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
27	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
28	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
29	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
30	0.000	0	0.000	0.000	0.000	0.000		0.000		60	140	0
SUM	-0.000	-	0.000	0.030	0.000	0.000	N.A.	-0.029	N.A.	-	-	0
AVG	-0.000	50	0.000	0.001	0.000	0.000	N.A.	-0.001	N.A.	60	140	0
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND
REPORT PERIOD: NOVEMBER,1978

SOLAR/1056-78/11

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.000	0	0.000	0.000	0.000	0.000	N	0.000	N	72	48
2	0.000	0	0.000	0.000	0.000	0.000	O	0.000	O	72	51
3	0.000	0	0.000	0.000	0.000	0.000	T	0.000	T	74	51
4	0.000	0	0.000	0.000	0.000	0.000		0.000		74	51
5	0.000	0	0.000	0.000	0.000	0.000	A	0.000	A	71	50
6	0.000	0	0.000	0.000	0.000	0.000	P	0.000	P	71	50
7	0.000	0	0.000	0.000	0.000	0.000	P	0.000	P	72	55
8	0.020	100	0.020	0.003	0.000	0.000	L	0.007	L	68	49
9	0.020	100	0.020	0.004	0.000	0.000	I	0.012	I	69	51
10	0.000	0	0.000	0.000	0.000	0.000	C	0.000	C	71	51
11	0.000	0	0.000	0.000	0.000	0.000	A	0.000	A	71	52
12	0.102	100	0.102	0.021	0.000	0.000	B	0.069	B	67	44
13	0.087	100	0.087	0.020	0.000	0.000	L	0.060	L	67	42
14	*	*	*	0.012	0.000	0.000	E	*	E	66	56
15	*	*	*	0.037	*	*		*		70	52
16	0.092	100	0.092	0.027	0.000	0.000		0.067		68	43
17	0.225	85	0.191	0.048	0.034	0.034		0.090		67	47
18	0.044	79	0.034	0.007	0.009	0.009		0.014		70	58
19	0.092	89	0.082	0.021	0.010	0.010		0.043		68	46
20	0.105	100	0.105	0.027	0.000	0.000		0.075		68	41
21	0.274	88	0.241	0.061	0.033	0.033		0.142		66	34
22	0.330	76	0.250	0.049	0.081	0.081		0.102		66	33
23	0.249	75	0.186	0.038	0.063	0.063		0.077		67	37
24	0.169	75	0.127	0.026	0.043	0.043		0.052		66	45
25	0.346	76	0.262	0.051	0.084	0.084		0.107		66	37
26	0.397	75	0.299	0.060	0.098	0.098		0.124		65	26
27	0.382	74	0.284	0.059	0.098	0.098		0.119		65	27
28	0.275	73	0.200	0.046	0.075	0.075		0.083		66	36
29	0.236	73	0.173	0.040	0.064	0.064		0.070		67	40
30	0.167	73	0.122	0.027	0.045	0.045		0.050		67	44
SUM	3.873	-	3.083	0.685	0.762	0.762	N.A.	1.461	N.A.	-	-
AVG	0.129	80	0.103	0.023	0.025	0.025	N.A.	0.049	N.A.	69	45
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: M.F. SMITH, JAMESTOWN, RHODE ISLAND
REPORT PERIOD: NOVEMBER,1978

SOLAR/1056-78/11

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1794	N	48	55	N	N	N
2	2050	O	51	60	O	O	O
3	2082	T	51	62	T	T	T
4	631		51	55			
5	358	A	50	52	A	A	A
6	243	P	50	*	P	P	P
7	1067	P	55	61	P	P	P
8	125	L	49	*	L	L	L
9	1999	I	51	57	I	I	I
10	1773	C	51	60	C	C	C
11	324	A	52	55	A	A	A
12	332	B	44	47	B	B	B
13	1530	L	42	46	L	L	L
14	309	E	56	58	E	E	E
15	1752		52	55			
16	1051		43	47			
17	269		47	49			
18	1394		58	65			
19	1870		46	52			
20	1837		41	46			
21	156		34	33			
22	191		33	34			
23	485		37	39			
24	262		45	46			
25	1121		37	*			
26	2024		26	29			
27	208		27	25			
28	152		36	33			
29	929		40	42			
30	1222		44	*			
SUM	29541	N.A.	-	-	-	-	-
AVG	985	N.A.	45	48	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

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